List of Acronyms

ACAP	=	Alternative Cover Assessment Program
ALCD	=	Alternative Landfill Cover Demonstration
AOS	=	apparent opening size
ARAR	=	applicable or relevant and appropriate requirement
ASTM	=	American Society for Testing and Materials
BOD	=	biological oxygen demand
BTEX	=	benzene, toluene, ethylbenzene, and xylenes
C&DW	=	construction and demolition waste
CAA	=	Clean Air Act
CCL	=	compacted clay liner
CERCLA	=	Comprehensive Environmental Response, Compensation and Liability Act
CFR	=	U.S. Code of Federal Regulations
CH	=	high-plasticity clay (according to USCS)
CL	=	low-plasticity clay (according to USCS)
COD	=	chemical oxygen demand
CQA	=	construction quality assurance
CQC	=	construction quality control
CSPE	=	chlorosulfonated polyethylene
CSPE-R	=	chlorosulfonated polyethylene - reinforced
DOE	=	U.S. Department of Energy
EG	=	emissions guidelines
EIA-R	=	ethylene interpolymer alloy-reinforced
EPA	=	U.S. Environmental Protection Agency
EPS	=	expanded polystyrene
ET	=	Evapotranspiration
FDEP	=	Florida Department of Environmental Protection
FDR	=	frequency domain reflectometry
FHWA	=	Federal Highway Administration
FID	=	flame ionization detector
FOS	=	filtration opening size
FS	=	factor of safety
fPP	=	flexible polypropylene
fPP-R	=	flexible polypropylene reinforced
GC	=	geocomposite
GCL	=	geosynthetic clay liner
GM	=	geomembrane
GN	=	geonet
GPR	=	ground penetrating radar
GPS	=	global positioning system
GT	=	geotextile
HAP		hazardous air pollutants
HDPE	=	high density polyethylene

HELP	=	Hydrologic Evaluation of Landfill Performance
HW	=	hazardous waste
HSWA	=	Hazardous and Solid Waste Amendment
ISM	=	instantaneous surface monitoring
ISS	=	integrated surface sampling
IW	=	industrial waste
L	=	Liters
LandGEM	=	EPA Landfill Gas Generation Model
LCRS	=	leachate collection and removal system
LDLPE	=	low density linear polyethylene
LDR	=	Land Disposal Restrictions
LDS	=	leak detection system
LE	=	limit equilibrium
LEACHM	=	Leachate Estimation and Chemistry Model
LLDPE	=	linear low density polyethylene
LMDPE	=	linear medium density polyethylene
lphd	=	liter/hectare/day (1 lphd = 9.35 gallon/acre/day (gpad))
MACT	=	maximum achievable control technology
MCL	=	maximum contaminant level
MSE	=	mechanically stabilized earth
MSW	=	municipal solid waste
MSWLF	=	municipal solid waste landfill
NCDC	=	National Climatic Data Center
NCP	=	National Contingency Plan
NESHAP	=	National Emission Standards for Hazardous Air Pollutants
NMOC	=	non-methane organic compound
NPDES	=	National Pollution Discharge Elimination System
NRC	=	U.S. Nuclear Regulatory Commission
NRCS	=	National Resources Conservation Service
NSPS	=	New Source Performance Standards
OII	=	Operating Industries, Inc.
OU	=	operable unit
PCB	=	polychlorinated biphenyl
PCDD	=	polychlorinated dibenzo-p-dioxins
PCDF	=	polychlorinated dibenzo-furans
PE	=	polyethylene
PERM	=	permanent erosion and revegetation material
PET	=	potential evapotranspiration
PHGA	=	peak horizontal ground acceleration
PMP	=	probable maximum precipitation
PPL	=	priority pollutant list
ppm	=	parts per million
PVC	=	polyvinyl chloride
QA	=	quality assurance
QC	=	quality control
ROD	=	Record of Decision

RCRA	=	Resource Conservation and Recovery Act
RCPS	=	rigid cellular polystyrene
RUSLE	=	Revised Soil Loss Equation
RWEQ	=	Revised Wind Erosion Equation
SARA	=	Superfund Amendments and Reauthorization Act
SASW	=	spectral analysis of surface waves
SC	=	clayey sand (according to USCS)
SCS	=	USDA Soil Conservation Service
SDRI	=	sealed double-ring infiltrometer
SE	=	southeast
SITE	=	Superfund Innovative Technology Evaluation
SMCL	=	secondary maximum contaminant level
SVOC	=	semivolatile organic compound
SVT	=	solvent vapor transmission
SWRRB	=	Simulation for Water Resources in Rural Basins
TDR	=	time domain reflectometry
TDS	=	total dissolved solids
TERM	=	temporary erosion and revegetation material
TR-55	=	Technical Release 55 (SCS, 1986)
TRM	=	turf reinforcement mat
TSS	=	total suspended solids
TOC	=	total organic carbon
TOC	=	total organic compound (in Chapter 5)
UMTRA	=	Uranium Mill Tailings Remedial Action
UMTRCA	=	Uranium Mill Tailings Radiation Control Act
USCS	=	Unified Soil Classification System
USDA	=	United States Department of Agriculture
USFWS	=	U.S. Fish and Wildlife Service
USGS	=	U.S. Geological Survey
USLE	=	Universal Soil Loss Equation
VFPE	=	very flexible polyethylene
VLDPE	=	very low density polyethylene
VOA	=	volatile organic acid
VOC	=	volatile organic compound
WES	=	U.S. Army Corps of Engineers Waterways Experiment Station
WVT	=	water vapor transmission
XPS	=	extruded polystyrene

List of Variables

A	=	dimensionless parameter (dimensionless)
A	=	area of emitting source (m^2) (in Chapter 5)
A_b	=	area of drainage basin or subbasin per basin or subbasin width (m^2/m)
A_s	=	average annual soil loss by sheet and rill erosion (tonnes/ha/yr)
a_a	=	cohesion (for internal strength) or adhesion (for an interface) for the critical potential slip surface above the hydraulic barrier (Pa)
a_{ai}	=	apparent adhesion (for an interface) or cohesion (for internal strength) for the critical potential slip surface (Pa), as defined in Figure 6-8
a_b	=	cohesion (for internal strength) or adhesion (for an interface) for the critical potential slip surface below the hydraulic barrier (Pa)
a_i	=	adhesion (for an interface) or cohesion (for internal strength) for the critical potential slip surface (Pa)
B	=	dimensionless parameter (dimensionless)
B	=	Distance over which differential settlement, Δ, occurs (m)
C	=	vegetative cover and management factor (dimensionless)
C_d	=	empirical factor (dimensionless)
C_e	=	void ratio correction factor (dimensionless)
C_F	=	vegetal cover factor (dimensionless)
C_I	=	vegetal retardance curve index (dimensionless)
C_r	=	runoff coefficient (dimensionless)
C_s	=	surface layer coefficient (dimensionless)
CN	=	runoff curve number (dimensionless)
COG	=	combined crop factors (dimensionless)
$C_{\alpha\varepsilon}$	=	modified secondary compression index (dimensionless)
$C_{\alpha\varepsilon 1}$	=	modified secondary compression index during the intermediate secondary compression period (dimensionless)
$C_{\alpha\varepsilon 2}$	=	modified secondary compression index during the long-term secondary compression period (dimensionless)
$C_{i,1}$-$C_{i,2}$	=	concentration gradient of species i (Mg/m^3)
c	=	runoff coefficient (dimensionless)
c_s	=	cohesion of soil material above the critical potential slip surface (Pa)
D	=	flow depth (m)
D_i	=	depth of influence (m)
D_i	=	diffusivity of species i through cover material (m/yr^2) (in Chapter 5)
D_{15}	=	particle size at which 15% by dry weight of the soil particles are smaller (mm)
D_{50}	=	minimum gravel or riprap mean particle size to withstand the peak rate of runoff (mm)
D_{85}	=	particle size at which 85% by dry weight of the soil particles are smaller (mm)

d	=	depth of rainfall in time of concentration from a storm with a certain return period (m)
E	=	equivalency factor (dimensionless)
E_v	=	vertical evaporative flux (mm/day)
EF	=	erodible fraction (dimensionless)
ER_i	=	mass emission rate of species i (Mg/yr)
ET	=	evapotranspiration (mm/day)
F	=	flow concentration factor (dimensionless)
F_w	=	seepage force (N)
FS	=	factor of safety (dimensionless)
FS_A	=	factor of safety for critical potential slip surface above the hydraulic barrier (dimensionless)
FS_B	=	factor of safety for critical potential slip surface below the hydraulic barrier (dimensionless)
FS_{min}	=	minimum acceptable factor of safety (dimensionless)
f(S)	=	slope function (dimensionless)
f_w	=	seepage force per unit volume (N/m^3)
G	=	dynamic shear modulus (Pa)
G/G_{max}	=	dynamic shear modulus reduction factor (dimensionless)
G_s	=	specific gravity of gravel or riprap (dimensionless)
G_{max}	=	maximum small-strain dynamic shear modulus (Pa)
g	=	acceleration of gravity (m/s^2)
H	=	height of the falling weight (m)
H_f	=	elevation difference along flow path (m)
H_s	=	soil layer thickness (m)
H_w	=	depth of water that can be stored in a soil layer for subsequent removal by plants
H_1	=	height of waste at time t_1 (m)
H_2	=	height of waste at time t_2 (m)
ΔH_s	=	secondary waste settlement (m)
h	=	height of slope (m), as defined in Figure 6-4
h_a	=	relative humidity of the air (dimensionless)
h_{avg}	=	average hydraulic head (m)
h_m	=	maximum head in drainage layer (m)
h_u	=	height of slope above the slope grade break (m), as illustrated in Figure 6-6
h_r	=	relative humidity at the soil surface (dimensionless)
h_z^*	=	minimum head at which flow into the coarser-grained layer first occurs (m)
I	=	infiltration into surface cover soil (mm/day)
i	=	hydraulic gradient (dimensionless)
i_r	=	rainfall intensity (m/s)
K	=	soil erodility factor (dimensionless)
K’	=	soil roughness factor (dimensionless)
k	=	hydraulic conductivity (m/s)

k	=	methane generation rate constant (yr^{-1}) (in Chapter 5)
k_{cs}	=	cover soil saturated hydraulic conductivity (m/s)
k_d	=	drainage layer hydraulic conductivity (m/s)
k_{ds}	=	granular drainage layer hydraulic conductivity (m/s)
k_f	=	long-term field hydraulic conductivity of granular drainage layer (m/s)
k_g	=	gas conductivity (m/s)
k_h	=	pseudo-static seismic coefficient (dimensionless)
k_l	=	laboratory hydraulic conductivity of granular drainage layer (m/s)
k_n	=	cross-plane hydraulic conductivity of geotextile (m/s)
k_s	=	saturated hydraulic conductivity (m/s)
k_u	=	unsaturated hydraulic conductivity (m/s)
k_y	=	pseudo-static seismic coefficient that produces a psuedo-static slope stability FS of 1.0 (dimensionless)
k_yg	=	yield acceleration (m/s^2)
L	=	lateral drainage (mm/day)
L_d	=	length of drainage layer flow path (m)
L_f	=	length of overland flow path (m)
L_{fg}	=	thickness of finer-grained soil layer (m)
L_0	=	methane generation potential (m^3/Mg)
LS	=	slope length and steepness factor (dimensionless)
l	=	slope length (m)
M_i	=	mass of solid waste in the i^{th} section (Mg)
M_W	=	earthquake moment magnitude (dimensionless)
n	=	Manning's roughness coefficient for the considered vegetative cover (dimensionless)
n_p	=	porosity of gravel or riprap layer (dimensionless)
n_s	=	Manning's roughness coefficient for the bare soil (dimensionless)
0_{95}	=	the 95% opening size of the geotextile (mm)
P_a	=	vapor pressure in the air above the evaporating surface (Pa)
P_c	=	conservation support practice factor (dimensionless)
P	=	precipitation (mm/day)
PERC	=	percolation through the cover system (mm/day)
PERC*	=	percolation through the cover soil (mm/day)
PET	=	potential evapotranspiration (mm/day)
Q(x)	=	mass transport of soil at downwind distance x (kg/m)
Q_M	=	maximum expected gas generation flow rate (Mg/yr)
Q_{max}	=	mass transport of soil (kg/m)
$Q(x)_{max}$	=	maximum mass transport of soil at downwind distance x (kg/m)
Q	=	peak rate of runoff (m^3/s/m)
q_c	=	flow capacity of drainage layer (m^3/s/m)
q_m	=	maximum flow rate in drainage layer (m^3/s/m)
R	=	runoff (mm/day)
R_e	=	rainfall energy/erosivity factor (dimensionless)
R_f	=	permissible velocity reduction factor (dimensionless)
R_n	=	net radiant energy available at the surface (mm/day)

S	=	slope inclination (dimensionless)
S(z,t)	=	Sink term representing uptake by transpiration (s^{-1})
SCF	=	soil crust factor (dimensionless)
S_r	=	retention parameter (mm/day)
s(x)	=	field length scale (m)
T	=	geosynthetic tension above the potential slip surface (N/m)
t	=	thickness of material above the critical potential slip surface (m) (in Chapter 6)
t	=	time (s) (in Chapter 4)
t_a	=	thickness of soil layer at point A (m), as defined in Figure 6-5
t_{avg}	=	average thickness of soil layer between points A and B, which are defined in Figure 6-5 (m)
t_b	=	thickness of soil layer at point B (m), as defined in Figure 6-5
t_c	=	time of concentration (s)
t_d	=	drainage layer thickness (m)
t_{ds}	=	granular drainage layer thickness (m)
t_i	=	age of the i^{th} section (yr)
t_m	=	required thickness of the internal drainage layer (m)
t_w	=	thickness of water flow parallel to the slope (m), as defined in Figure 6-3
t^*_w	=	thickness of water in Wedge 1 (m), as defined in Figure 6-4;
t_1	=	starting time for the period of secondary compression (s)
t_2	=	t_1 plus the time duration of secondary compression or intermediate secondary compression (s)
t_3	=	T_2 plus the time duration of long-term secondary compression (s)
U_a	=	wind speed (km/hr)
v	=	flow velocity (m/s)
v_s	=	shear wave velocity of material (m/s)
$v_{s,\ waste}$	=	shear wave velocity of waste (m/s)
W	=	mass of the falling weight (tonne)
W_b	=	buoyant unit weight (N)
WF	=	weather factor (kg/m)
x	=	downwind distance (m)
x	=	cover thickness (m) (in Chapter 5)
x_c	=	critical distance along a slope before gully formation begins (m)
z	=	vertical coordinate (m)
Γ	=	slope of the saturation vapor pressure versus temperature curve at the mean temperature of the air (dimensionless)
Ψ	=	geotextile permittivity (s-1)
ψ	=	matric potential (negative) due to capillary suction forces (N/m2)
α	=	empirical constant $(m/tonne)^{0.5}$
β	=	slope angle (degrees)
γ_b	=	average buoyant unit weight of material above the critical potential slip surface (N/m^3)
γ_{sat}	=	average saturated unit weight of material above the critical potential slip surface (N/m^3)

γ_t = total unit weight of material above the critical potential slip surface or total unit weight of material (N/m^3)
$\gamma_{t,\ waste}$ = total unit weight of waste (N/m^3)
γ_w = unit weight of water (N/m^3)
Δ = differential settlement (m)
$\Delta W_{foliage}$ = change in water storage on plant foliage (mm/day)
ΔW_{soil} = change in water storage in cover system soil (mm/day)
$\Delta W_{surface}$ = change in water storage at surface (mm/day)
δ = shear displacement (m)
θ = soil volumetric moisture content (dimensionless)
θ_a = air transmissivity ($m^3/s/m$)
θ_{afc} = soil apparent field capacity (dimensionless)
θ_{allow} = allowable hydraulic transmissivity of geosynthetic drainage layer ($m^3/s/m$)
θ_{dg} = geosynthetic drainage layer transmissivity ($m^3/s/m$)
θ_{ds} = granular drainage layer transmissivity ($m^3/s/m$)
θ_{fc} = soil field capacity (dimensionless)
θ_h = hydraulic transmissivity ($m^3/s/m$)
θ_{sc} = soil water storage capacity (dimensionless)
θ_{ult} = ultimate hydraulic transmissivity of geosynthetic drainage layer ($m^3/s/m$)
θ_{wp} = soil wilting point (dimensionless)
λ = pore size distribution index (dimensionless)
μ_a = air viscosity (kg/m/s)
μ_w = water viscosity (kg/m/s)
ρ_a = air density (kg/m^3)
ρ_w = water density (kg/m^3)
σ_n = normal stress (kPa)
τ = shear stress (Pa)
$\tau_{\mathbf{a}}$ = allowable shear stress (kPa)
$\tau_{\mathbf{ab}}$ = allowable shear stress for the surface layer with bare soil (kPa)
$\tau_{\mathbf{ah}}$ = allowable shear stress for the Horton/NRC method (kPa)
$\tau_{\mathbf{e}}$ = effective shear stress applied to the surface layer by the flowing water (kPa)
ν = psychrometric constant (dimensionless)
ϕ = angle of repose or gravel or riprap (degrees)
ϕ_i = angle of internal or interface friction for the critical potential slip surface (degrees)
ϕ_a = angle of internal or interface friction for the critical potential slip surface above the hydraulic barrier (degrees)
ϕ_b = angle of internal or interface friction for the critical potential slip surface below the hydraulic barrier (degrees)
ϕ_s = angle of internal friction for the soil material (i.e., protection layer and/or granular drainage layer) above the critical potential slip surface (degrees)

ϕ_{si}	=	secant angle of internal or interface friction for the critical potential slip surface (degrees), as defined in Figure 6-8
ϕ_{ti}	=	tangent angle of internal or interface friction for the critical potential slip surface (degrees), as defined in Figure 6-8